

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

FOUR NEW PARASITIC COPEPODS
OF THE FAMILY CHONDRACANTHIDAE
FROM CALIFORNIA INSHORE FISHES

BY JU-SHEY HO

*Department of Biology, California State University,
Long Beach, California 90840*

The four new species of chondracanthid copepods described in the following are part of a collection of parasitic copepods made by Mr. Edmund Hobson, National Marine Fisheries Service, at La Jolla, California. The collection was sent to Dr. Roger F. Cressey, Smithsonian Institution, who in turn passed the chondracanthid specimens to me for identification.

All material has been deposited in the Smithsonian Institution, except the dissected specimens that were mounted on slides and kept in the author's collection.

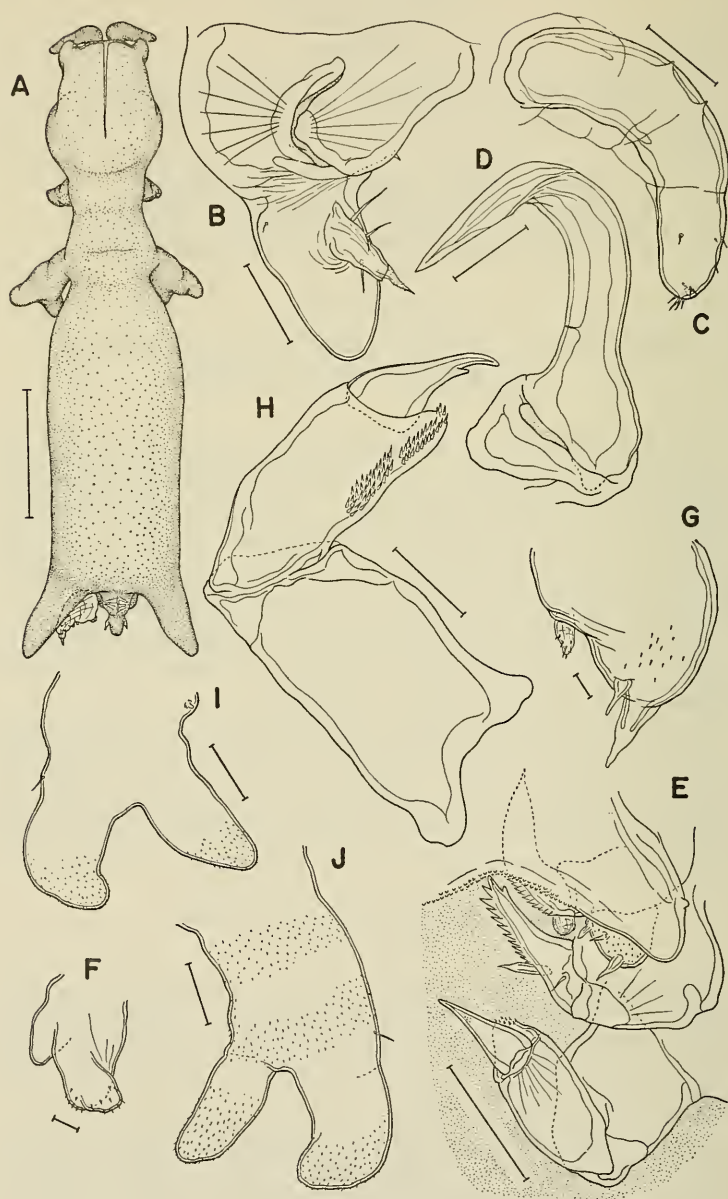
This study has been aided by the grants from Long Beach California State College Foundation and from the National Science Foundation (GB 8381X) to Dr. Arthur G. Humes, Director of Boston University Marine Program, Marine Biological Laboratory, Woods Hole, Massachusetts.

***Acanthochondria fraseri* new species**

Figures 1-2

Material studied: 61 ♀♀ (each carrying a ♂) collected from the gill cavity of *Pleuronichthys coenosus* Giard. Holotype ♀ (USNM 134662) and 46 paratype ♀♀ (USNM 134663) collected on 4 December 1968; 4 ♀♀ on 6 July 1968; 2 ♀♀ on 19 July 1968; 6 ♀♀ on 6 August 1968 and 2 ♀♀ on 15 January 1969.

Female: Body (Fig. 1A) small and rather cylindrical. Head longer than wide, with small rounded knob at each anterior corner and swollen posterolateral surface. First and second pedigerous segments narrower than head. Third and fourth pedigerous segments fused into a cylindrical trunk. Posterior processes either diverged or converged. Genital segment (Fig. 1B) distinctly wider than long. Abdomen (Fig. 1B) about as long



as genital segment, with widest portion occurring at the level where the caudal rami protrude. Caudal ramus (Fig. 1B) bearing 3 setae, 1 small subterminal knob, and a spinulose terminal process. Egg sac shorter than body, with many rows of eggs.

First antenna (Fig. 1C) fleshy and cylindrical; armature being (from proximal to distal) 1-1-2-2-8. Second antenna (Fig. 1D) 2 segmented; terminal segment a strong, recurved hook. Labrum (Fig. 1E) with denticulated posterior margin. Mandible (Fig. 1E) 2 segmented, terminal blade bearing 31 teeth on convex (inner) side and 28 teeth on concave (outer) side. Paragnath (Fig. 1F) bilobate and spinulose. First maxilla (Fig. 1G) bearing 3 elements. Second maxilla (Fig. 1E) 2 segmented; first segment robust and unarmed; second segment bearing 1 small, simple seta, 1 large seta with hyaline tip, a row of 11 teeth on posterior surface, and a single subterminal tooth on anterior surface. Maxilliped (Fig. 1H) 3 segmented; first segment unarmed, second segment with 2 patches of denticles, and terminal segment a claw with a small hooklet. Both leg 1 (Fig. 1I) and leg 2 (Fig. 1J) bilobate and bearing fine spinules. Spinulation on legs confined to distal portion of both rami on anterior surface (Fig. 1I). Protopod bearing a small outer seta. Leg 2 always larger than leg 1.

Measurements: Body ranging from 2.60 mm to 4.84 mm; head 1.04×0.83 mm; genital segment 0.22×0.33 mm; abdomen 0.21×0.15 mm; egg sacs 3.63 and 3.70 mm.

Male: Body (Fig. 2A) $627 \times 264 \mu$, with swollen cephalosome and cylindrical metasome and urosome. Main body flexure located between first and second pedigerous segments. A single setule on lateral surface of second and third pedigerous segments. Fourth pedigerous segment rather distinct but unarmed. Genital segment bearing usual ventrolateral ridges. Abdomen indistinguishably fused with genital segment and carrying a pair of setules on dorsal surface. Caudal ramus as in female, only smaller.

First antenna (Fig. 2B) elongate and cylindrical; with usual armature of 1-1-2-2-8. Second antenna (Fig. 2B) indistinctly 2 segmented; first segment short, stout and unarmed; second segment a recurved hook bearing an inner setule. Rostral area bearing a median protrusion located between bases of second antennae (Fig. 2B). Labrum with denticulated posterior surface as in female. Mandible different from that of female in having only 16 teeth on convex side and 10 teeth on concave side.

←

FIG. 1. *Acanthochondria fraseri* n. sp., female: A, body, dorsal; B, genito-abdomen, lateral; C, first antenna; D, second antenna; E, mouth parts; F, paragnath; G, first maxilla; H, maxilliped; I, leg 1; J, leg 2. Scale: 1 mm in A; 0.1 mm in B, C, D, E, I, J; 0.01 mm in F, G; 0.05 mm in H.

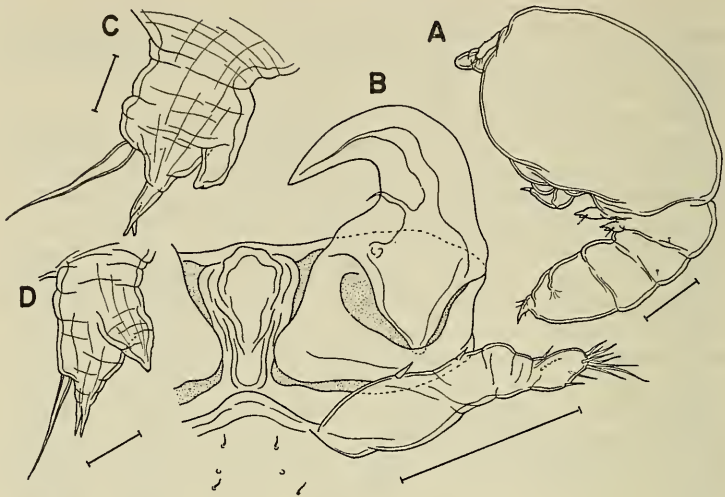


FIG. 2. *Acanthochondria fraseri* n. sp., male: A, body, lateral; B, first and second antennae; C, leg 1; D, leg 2. Scale: 0.1 mm in A; 0.05 mm in B; 0.01 mm in C, D.

Paragnath, first maxilla, and maxilliped as in female. Second maxilla showing usual sexual dimorphism in having naked terminal process. Leg 1 (Fig. 2C) larger than leg 2 (Fig. 2D). Both legs similarly constructed; with protopod bearing a long outer seta; exopod a small lobe tipped with 2 elements; and endopod a smaller unarmed conical lobe. Surface of legs without spinules.

Etymology: The species is named for Mr. C. M. Fraser who first discovered the present species.

Remarks: In the summer of 1967, while making a revisional study of the chondracanthid copepods in the Smithsonian Institution, I found a vial (USNM 60526) labelled as "*Acanthochondria rectangularis* (Fraser)" containing seven specimens of two apparently different forms. They were collected by C. M. Fraser from *Platichthys stellatus* (Pallas) at Vancouver Island, British Columbia. Three of them are distinctly larger (with the smallest measuring 6.41 mm long) and are unmistakably attributable to what Fraser (1920) has described as "*Chondracanthus rectangularis*." The remaining four smaller specimens (with the largest measuring 3.35 mm long) are, however, not attributable to any known species of *Acanthochondria*. They are different from *A. rectangularis* in having 1) a cylindrical first antenna, 2) denticulated labrum, 3) only one row of teeth on the concave side of mandible, and 4) only 31 teeth on the convex side of the mandible (it is 54 in *A. rectangularis*). The *Acanthochondria* from

La Jolla is apparently identical with the smaller forms of Fraser's "*Chondracanthus rectangularis*." Hence, it is named *fraseri* in commemorating Mr. Fraser's first discovery of the present species.

***Chondracanthus heterostichi* new species**

Figures 3-4

Material studied: 16 ♀♀ (each carrying a ♂) collected from the gill cavity of *Heterostichus rostratus* Giard. Holotype ♀ (USNM 134660) and 6 paratype ♀♀ (USNM 134661) collected on 5 September 1968; 2 ♀♀ on 28 June 1968; 2 ♀♀ on 8 July 1968; 1 ♀ on July 1968; 3 ♀♀ on 11 July 1968; and 1 ♀ on 15 July 1968.

Female: Body (Figs. 33A, B) rather plump. Head slightly wider than long, with posteroventral surface, which is slightly protruded on each side into a bilobate protrusion. First pedigerous segment narrower than head, with or without a dorsal process. Second pedigerous segment wider than head, bearing a cylindrical lateral process. Third and fourth pedigerous segments fused into a large trunk, bearing two dorsal processes, one lateral process on each side, and a pair of rather long posterior processes. Both genital segment and abdomen wider than long. A pair of small vermiform processes located ventrally in front of the genital segment (Fig. 3C). Egg sac longer than body, containing many rows of eggs.

First antenna (Fig. 3D) large, distinctly bipartite; basal part elongated rather than inflated; distal part small; armature being 1-1-1-2-2-8. Second antenna (Fig. 3E) a strong recurved hook. Labrum (Fig. 3F) with smooth posterior surface. Mandible armed with a row of 60 teeth on convex surface and 2 rows of (4 and 43) teeth on concave surface. Paragnath with a small basal lobe. First maxilla bearing 3 elements. Second maxilla (Fig. 3F) of usual form, bearing a row of 15-18 teeth on posterior surface of terminal process. Maxilliped (Fig. 3F) 3 segmented, terminal segment bearing a hooklet. Leg 1 (Fig. 3G) bilobate; bearing fine spinules on entire anterior surface, but on posterior surface they are restricted to distal portion of the rami. Leg 2 (Fig. 3H) larger than leg 1; with similar spinulation. Both legs carrying an outer seta on distal surface of protopod.

Measurements: Body ranging from 2.42 to 4.09 mm; head 0.83×0.86 mm; genital segment 0.25×0.41 mm; abdomen 0.17×0.21 mm; egg sacs 6.68 and 6.56 mm.

Male: Body (Fig. 4A) $556 \times 272 \mu$; with its general appearance similar to that of *A. fraseri*.

First antenna (Fig. 4B) cylindrical, bearing a group of 8 rather long setae at tip. Second antenna a stout, recurved hook bearing an accessory antennule as shown in Figure 4B. Labrum as in female, but bearing a median and a lateral knob. Mandible bearing 24 teeth on convex side and 4 and 20 (in 2 rows) on concave side. First maxilla as in female, except having a relatively larger outer element. Second maxilla showing

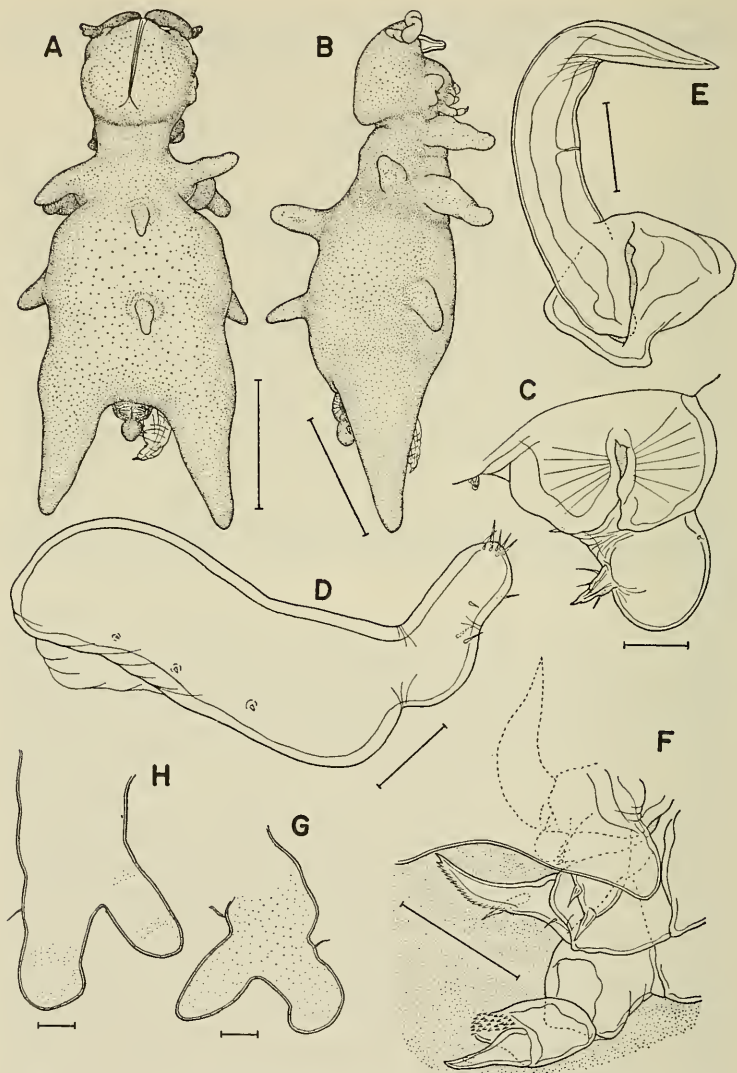


FIG. 3. *Chondracanthus heterostichi* n. sp., female: A, body, dorsal; B, body, lateral; C, genito-abdomen, lateral; D, first antenna; E, second antenna; F, mouth parts; G, leg 1; H, leg 2. Scale: 1 mm in A, B; 0.1 mm in C, D, E, F, G, H.

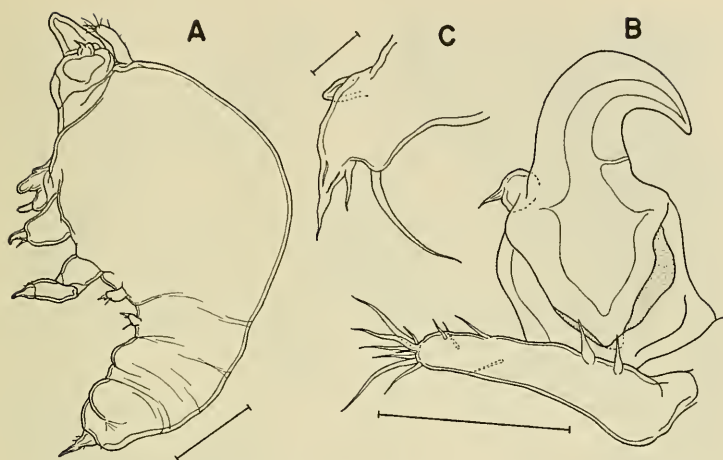


FIG. 4. *Chondracanthus heterostichi* n. sp., male: A, body, lateral; B, first and second antennae; C, leg 1. Scale: 0.1 mm in A; 0.05 mm in B; 0.01 mm in C.

usual sexual dimorphism in lacking teeth on terminal process. Maxilliped as in female. Leg 1 (Fig. 4C) larger than leg 2. Both similar to *A. fraseri*, except unequally developed 2 terminal elements on exopod.

Etymology: The specific name *heterostichi* refers to the host of the present species.

Remarks: *Ch. heterostichi* is distinguishable from other species of *Chondracanthus* in having two dorsal processes and two lateral processes on the trunk. *Ch. pusillus* Kabata, 1968 (parasitic on *Apodichthys flavidus* Giard in Departure Bay, Vancouver Island, British Columbia) is the only species that shows some similarities to the present species in the number and disposition of the body processes. However, the body processes of *Ch. pusillus* are in a form of knob rather than a drawn out process as in *Ch. heterostichi* and, furthermore, it lacks any form of outgrowths in the cephalic region.

Several specimens show an inconspicuous dorsal outgrowth in the neck region between the first and the second thoracic segment, and in one of the three specimens collected on 11 July, it is even as large as the two processes in the trunk region. Since all 16 females are ovigerous, these differences in the condition of the neck process seem to be an intraspecific variation that is not correlated with age or maturity of the female.

***Heterochondria atypica* new species**

Figures 5-7

Material studied: 18 ♀♀ (each carrying a ♂) collected from the gill filaments of *Oxyjulis californica* (Günther). Holotype ♀ (USNM 134664)

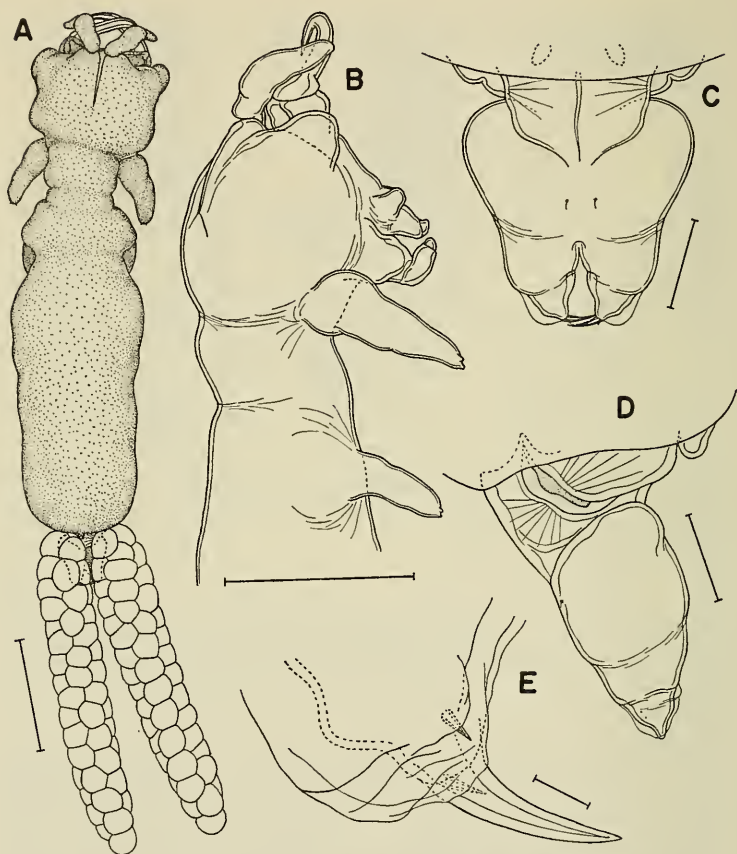


FIG. 5. *Heterochondria atypica* n. sp., female: A, body, dorsal; B, anterior portion of body, lateral; C, genito-abdomen, dorsal; D, genito-abdomen, lateral; E, caudal ramus. Scale: 0.5 mm in A, B; 0.1 mm in C, D; 0.01 mm in E.

2 paratype ♀♀ (dissected), and one other specimen collected on 23 September 1968; 3 ♀♀ on 14 October 1968; 2 ♀♀ on 15 October 1968; 2 ♀♀ on 18 October 1968; 2 ♀♀ on 30 October 1968; 1 ♀ on 31 October 1968.

Female: Body (Fig. 5A) cylindrical, without processes. Head wider than long, with a prominent knob on anterolateral corner. Another smaller knob located lateral to oral region (Fig. 5B). First pedigerous segment distinctly narrower than head, while second pedigerous segment nearly as wide as head. Third and fourth pedigerous segment fused into a large,

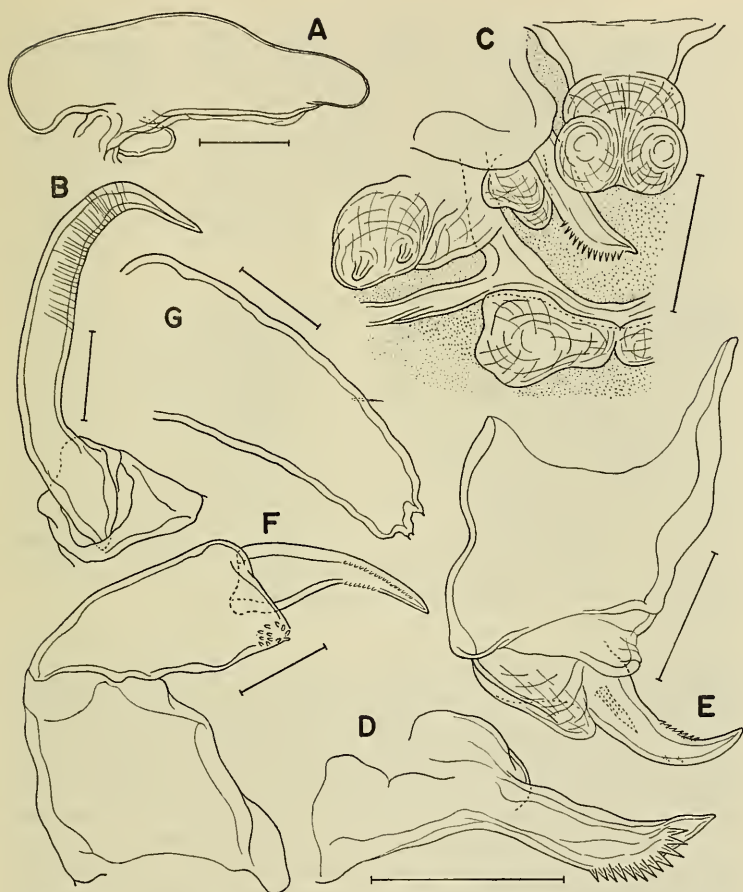


FIG. 6. *Heterochondria atypica* n. sp., female: A, first antenna; B, second antenna; C, mouth parts; D, mandible; E, second maxilla; F, maxilliped; G, leg 1. Scale: 0.1 mm in A, B; 0.05 mm in C, D, E, F, G.

cylindrical trunk which has a rounded off posterior end carrying no processes. Genital segment shorter than abdomen, which is characteristic in having a smaller anterolateral surface (Figs. 5C, D). Dorsal surface of abdomen bearing a pair of median spinules. Caudal ramus (Fig. 5E) tipped with 3 unequal spines (middle one the largest). A pair of vermiform processes located ventrally in front of genital segment (Figs. 5C, D). Egg sacs (Fig. 5A) shorter than body, containing few rows of eggs.

First antenna (Fig. 6A) fleshy and naked; with much shorter, conical, distal portion. Second antenna (Fig. 6B) 2 segmented; terminal segment

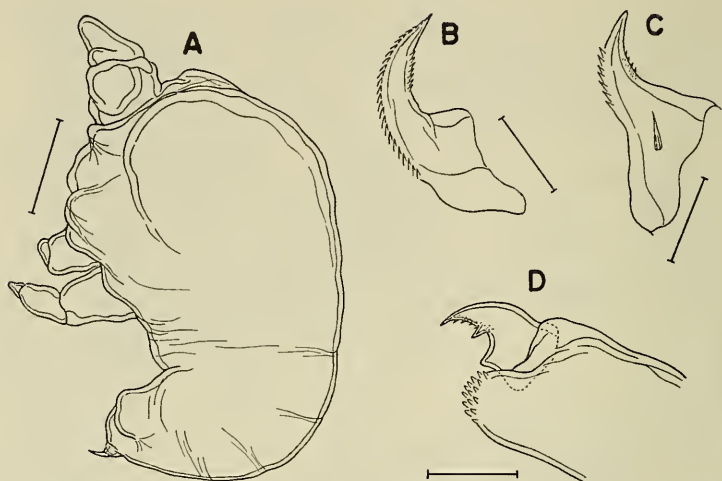


FIG. 7. *Heterochondria atypica* n. sp., male: A, body, lateral; B, mandible; C, distal segment of second maxilla; D, terminal portion of maxilliped. Scale: 0.05 mm in A; 0.01 mm in B, C, D.

a long, slender hook. Labrum (Fig. 6C) very characteristic, a conical plate tipped with a fleshy lobe which is bilobate at the tip. Mandible (Fig. 6D) a simple, pointed process armed subterminally with a row of 12 or 13 teeth. Paragnath a bilobate sac located postero-inner to the mandible (Fig. 6C). First maxilla tipped with two blunt elements (Fig. 6C). Second maxilla (Fig. 6E) 2 segmented; first segment swollen and unarmed; second segment a recurved process bearing 1 large spinous seta on proximal portion and a row of 4 to 7 teeth on anterior margin. Some specimens bearing 2 additional teeth on posterior surface. Maxilliped (Fig. 6F) 3 segmented; first segment unarmed; second segment bearing a patch of small teeth on disto-inner surface; and last segment a rather large claw bearing 2 rows of marginal teeth. A bipartite lobe located postero-inner to the base of first maxillae (Fig. 6C) probably representing labium. Leg 1 (Fig. 6G) unilobate, carrying a slender outer seta and tipped with 3 spinelike processes, of which the inner two are nearly fused. Leg 2 similar to leg 1, only slightly smaller.

Measurements: Body ranging from 1.62 to 2.86 mm; head $506 \times 693 \mu$ (including knobs); genital segment $143 \times 238 \mu$; abdomen $209 \times 221 \mu$; egg sacs 1.57 and 1.60 mm.

Male: Body (Fig. 7A) $253 \times 149 \mu$; with strongly curved urosome. Lateral surface of metasome lacking usual spinules. Caudal ramus as in female, only with a weakly sclerotized terminal claw.

First antenna absent. Second antenna as in usual form; a stout, recurved hook. Rostral protrusion present. Labrum as usual form seen in *A. fraseri* and *Ch. heterostichi*. Mandible (Fig. 7B) different from female in having 2 rows of teeth (25 on convex surface and 6 on concave surface). Maxilla having 2 terminal setae proportionately longer than in female. Second maxilla armed with 1 spinous seta and 2 rows of teeth on distal process (Fig. 7C). Maxilliped (Fig. 7D) different from female in terminal claw, which has a large toothlike basal projection, a single tooth on the middle surface and a terminal row of 5 small teeth. Legs absent.

Etymology: The specific name *atypica* (*a* = without, *typica* = typical) refers to the unusual feature of the denticulation in the female mandible.

Remarks: This is the second species of the genus *Heterochondria* known to occur in the North American waters. The first species *H. crassicornis* (Krøyer, 1835) is so far only known from the Gulf of Mexico and the Caribbean, parasitic on *Labrus* sp. and *Pomacentrus planifrons* (Ho, 1970). The Californian species is readily distinguishable from the five other species of the genus in having in the female a conical labrum with fleshy tip and only one row of teeth on the mandible. The uniserial denticulation in the mandible is also unique in the family.

Pseudodiocus new genus

Female: Body short, bearing processes. Head consisting of cephalosome and first pedigerous segment. Second pedigerous segment forming a short, wide neck and remaining pedigerous segments fused to form a stout trunk bearing a pair of large posterior processes. Genital segment well formed but abdominal segment extremely small or indistinct. Caudal ramus armed with 5 setae, with one of them much longer than the others. Egg sacs lobate, first antenna filiform and 3 segmented. Second antenna unknown. Oral appendages as in *Diocus*, except maxilliped that is more reduced. Only 1 pair of leg rudiments present, very small.

Male: Dwarf, with indistinct metamerism. Abdomen indistinct. Caudal ramus bearing 5 unequal elements. First antenna 4 segmented and setose. Second antenna uncinata, with accessory antennule. Oral appendages as in female, with usual sexual dimorphism in mandible. Two pairs of rudimentary legs present.

Type-species: *Pseudodiocus scorpaenus* new species.

Etymology: The generic name *Pseudodiocus* (*pseudo* = false) refers to its closeness to another chondracanthid genus *Diocus*. Gender masculine.

Remarks: The new genus, as indicated in the name, is most closely related to the genus *Diocus*. The first antenna, the mouth parts, the genital segment, and the abdomen are some of the structures that show the most remarkable similarities between the two genera. Nevertheless, the present genus is distinctly different from *Diocus* in having only one pair of rudimentary legs in the female and two pairs of such legs in the male.

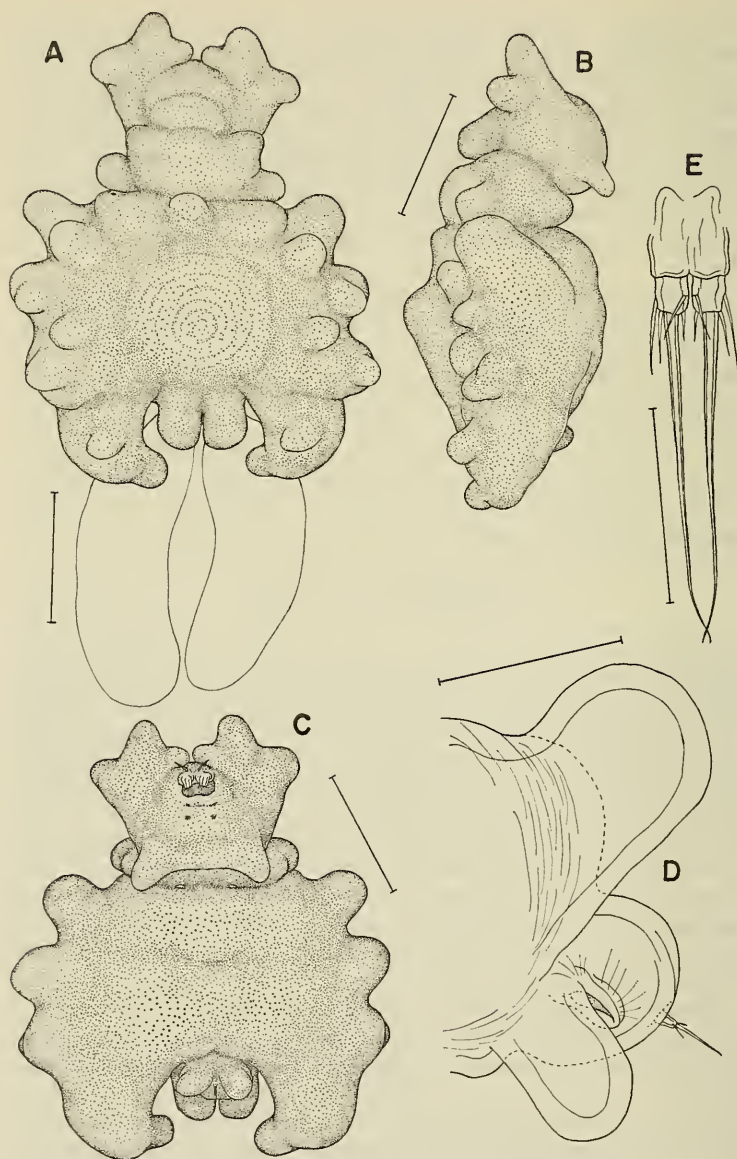


FIG. 8. *Pseudodiocus scorpaenus* n. gen., n. sp., female: A, body, dorsal; B, body, lateral; C, body, ventral; D, genito-abdomen; E, anal segment and caudal rami. Scale: 1 mm in A, B, C; 0.5 mm in D; 0.1 mm in E.

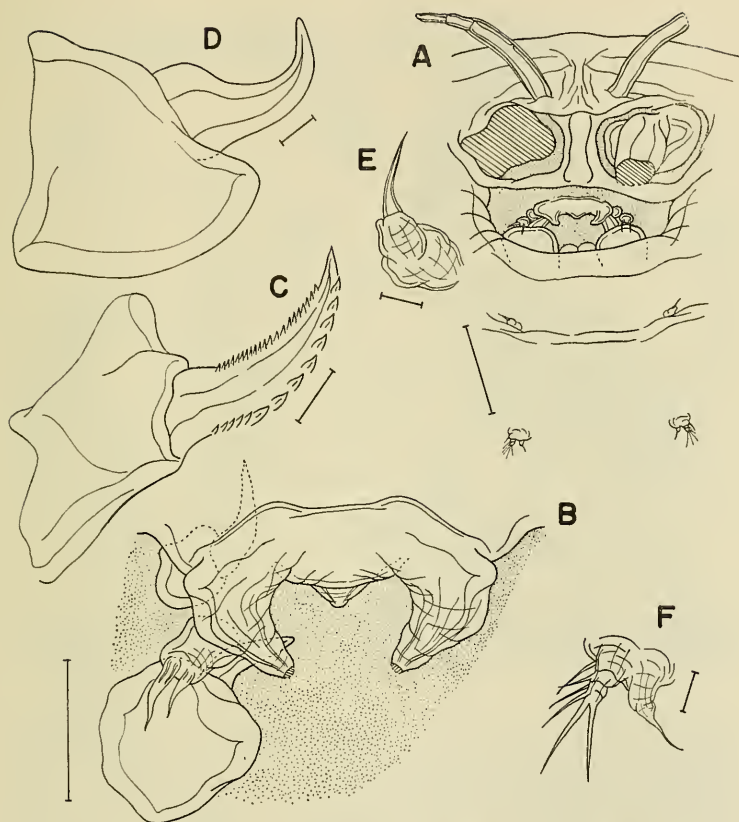


FIG. 9. *Pseudodiocus scorpaenus* n. gen., n. sp., female: A, antennal, oral, and postoral area; B, mouth parts; C, mandible; D, second maxilla; E, maxilliped; F, leg 1. Scale: 0.1 mm in A; 0.05 mm in B; 0.01 mm in C, D, E, F.

***Pseudodiocus scorpaenus* new species**

Figures 8-11

Material studied: 6 ♀♀ (three of them carrying ♂) collected from the gill cavity of *Scorpaena guttata* Giard. Holotype ♀ (USNM 134665, with a ♂ attached), 2 paratype ♀♀ (dissected for studying appendages) and 2 other ♀♀ collected on 10 October 1968; 1 ♀ on 16 October 1968.

Female: Body (Figs. 8A-C) short and wide, bearing many short processes. Head wider than long, with anterior corner expanded into a trilobate protuberance and posteroventral corner, a simple process. All six specimens showing a raised posterodorsal surface on head. First

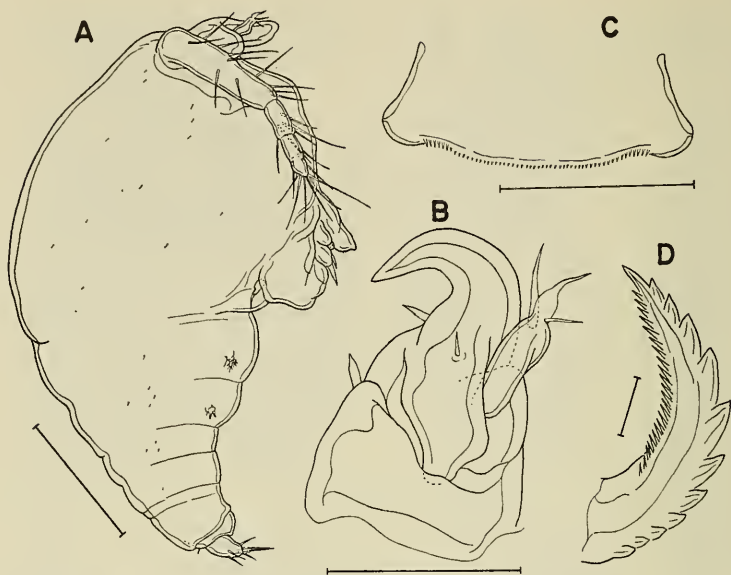


FIG. 10. *Pseudodiocus scorpaenus* n. gen., n. sp., female: A, body, lateral; B, second antenna; C, labrum; D, mandible. Scale: 0.1 mm in A; 0.05 mm in B, C; 0.01 mm in D.

pedigerous segment fused with cephalosome to form head. Second pedigerous segment forming the short but wide neck that bears a lateral protrusion. Remaining pedigerous segments fused to form the trunk, which bears 5 lateral stout tubercles, 2 dorsal swellings, and a pair of posteromedian processes that hang over the genito-abdomen. Posterior process large and bearing a dorsal tubercle. Genital segment (Fig. 8D) bearing a lateral lobe on each side anterior to the area of egg sac attachment. Abdomen inconspicuous, probably represented by a slightly raised area to where the caudal rami are attached. Caudal ramus (Fig. 8E) bearing 4 small, short setae and 1 large, long terminal seta. Egg sac (Fig. 8A) shorter than body; containing many rows of small eggs.

First antenna (Fig. 9A) filiform and 3 segmented, with proximal segment longer than 2 distal segments together. Second antenna broken in all 6 specimens examined. Mouth parts located in a depression immediately posterior to the antennal region, except maxillipeds that are found posterior to and out of the postantennal depression. Labrum (Fig. 9B) bearing 3 vermiform processes, without denticles. Mandible (Fig. 9C) armed with a row of 13 teeth on convex side and 21 teeth on concave side. First maxilla (Fig. 9B) tipped with 2 spinous setae. Second maxilla (Fig. 9D) with a naked terminal process. Maxilliped (Fig. 9E) greatly

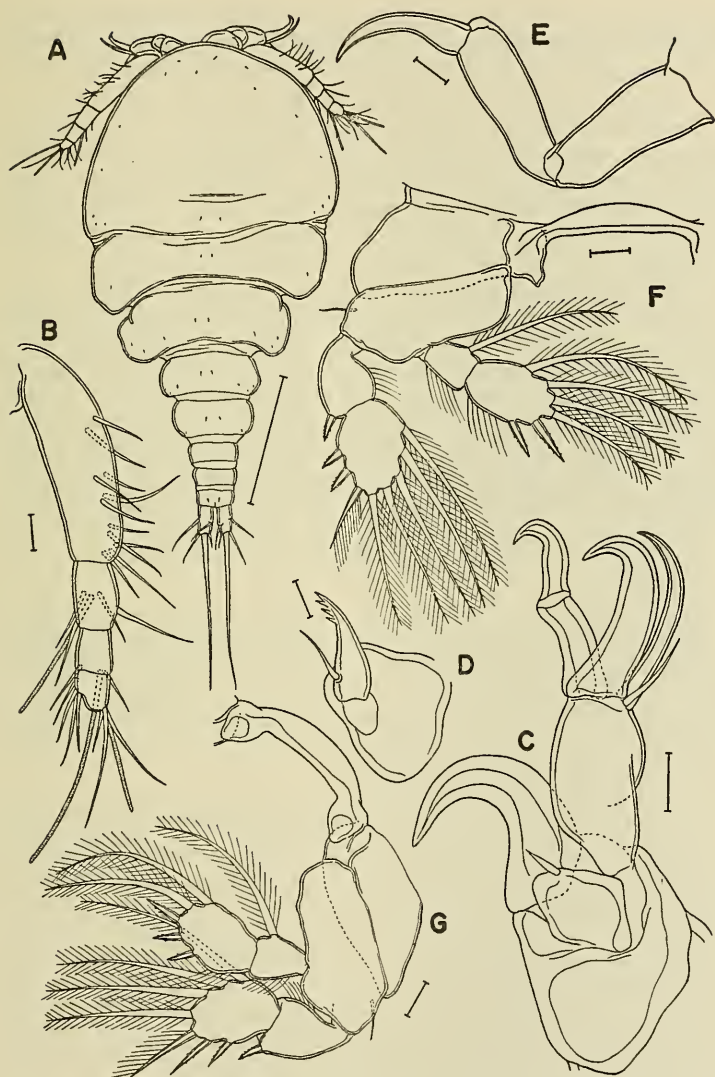


FIG. 11. *Pseudodiocus scorpaenus* n. gen., n. sp., copepodid: A, body, dorsal; B, first antenna; C, second antenna; D, second maxilla; E, maxilliped; F, leg 1 and intercoxal plate; G, leg 2 and intercoxal plate. Scale: 0.1 mm in A; 0.01 mm in B, C, D, E, F, G.

atrophied, but still with indication of 3-segmented condition. Leg 1 (Fig. 9F) greatly atrophied, biramous. Other legs absent.

Measurements: Body ranging from 1.77 to 3.35 mm; head 1.63×1.95 mm; genital segment 0.33×0.46 mm; egg sacs 3.04 and 2.6 mm.

Male: Body (Fig. 10A) $418 \times 243 \mu$; with greatest width at posterior portion of cephalosome. Metamerism on body rather distinct. Body surface scattered with some fine spinules. Genital segment with ventral ridges and abdomen carrying a pair of dorsal spinules. Caudal ramus armed as in female, only different in having a much shorter terminal element.

First antenna 3 segmented; terminal segment with an indication resulting from fusion of 2 segments. Armature on these segments being: 11, 5, and $2 + 7$. Second antenna (Fig. 10B) a recurved, stout hook carrying 3 setae and an accessory antennule, which is tipped with 3 elements. Labrum (Fig. 10C) bearing a row of spinules on posterior surface. Mandible (Fig. 10D) armed with a row of 23–25 small teeth on concave side and another row of 11–12 larger teeth on convex side. First maxilla tipped with 3 elements and second maxilla bearing 1 or 2 teeth on terminal process. Maxilliped atrophied as in female. Two pairs of biramous, atrophied legs.

Etymology: The specific name refers to the host *Scorpaena* of the present species.

Remarks: In order to find the true morphology of the second antenna of the adult female, I have examined 57 sculpins collected off Los Angeles Harbor, Huntington Beach, New Port Beach, and Catalina Island for some additional, intact specimens. However, not a single specimen of *P. scorpaenus* was found. Therefore, the structure of this appendage, which is in this case rather important in deciding the systematic status of the new genus, remains unknown.

One of the dissected female was found carrying two males, with one on the right side of the head and the other on the usual location in the vicinity of the genital segment. However, after a closer examination it was discovered that the one attached to the head region was actually a larval form still in the second copepodid stage (Fig. 11A). It has a distinctly segmented body and two pairs of unmodified legs (Figs. 11F, G). The first antenna (Fig. 11B) is not much different from that of the modified mature male, but the second antenna (Fig. 11C) is quite different in the fine structure of the accessory antennule, which is armed terminally with three hooks (one of them articulate) and one seta. The second maxilla (Fig. 11D) and the maxilliped (Fig. 11E) of the copepodid larva are also different from those of the adult.

The copepodid larva of *Diocus gobinus* (Müller, 1776) that was found attached to a young adult female was described by Hansen (1923) as having an accessory antennule like the present species. The second antenna of the male *Pseudodiocus* resembles that of the *Diocus* in bearing a well-developed accessory antennule. The same appendage in female *Diocus* is unique in possessing a T-shaped terminal part and lacking an

accessory antennule. If this is also proved to be the case in the female *Pseudodiocus*, then these two genera will be even more closely related to each other than it is suggested here.

LITERATURE CITED

- FRASER, C. M. 1920. Copepods parasitic on fish from the Vancouver Island Region. Proc. Trans. Roy. Soc. Canada, Ser. 3, 13(5): 45-67.
- HO, J. S. 1970. Revision of the Genera of the Chondracanthidae, a copepod family parasitic on marine fishes. Beaufortia 17(299): 105-218.
- KABATA, Z. 1968. Some Chondracanthidae (Copepoda) from fishes of British Columbia. Jour. Fish. Res. Bd. Canada 25(2): 321-345.
- KRØYER, H. 1835. Om snyltekrebsene, isaer med hensyn til den Danske Fauna. Naturh. Tidsskr. 1(2):172-208.
- HANSEN, A. V. 1923. Crustacea Copepoda, 2. Copepoda Parasita and Semiparasita. Danish Ingolf-Exped. 3(7):1-92.
- MÜLLER, O. F. 1776. Zoologiae Danicae prodromus, seu animalium Daniae et Norvegiae indigenarium characteres, nomina, et synonym imprimis popularium: 1-282. (Havniae.)